VERIFICATION OF TRANSLATION

I, Toyoaki Fukui, FUKUI & PARTNERS, of 1-19, Uchihonmachi 2-chome, Chuo-ku, Osaka-shi, Osaka, Japan, do hereby solemnly and sincerely declare:

that I have a competent knowledge of the English and Japanese Languages,

that the attached document is a true and correct translation made by me to the best of knowledge and belief of: Japanese Patent Application No. 2002-315654 filed on October 30, 2002 with Japan Patent Office.

Dated This 7th day of December 2006.

T. Fukui

Toyoaki Fukui
Translator

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[Expression of Fee]

[Deposit Account No.] 009483

[Amount of payment] 21,000 yen

[List of Attached Articles]

[Document Name] Specification 1

[Document Name] Drawings 1

[Document Name] Abstract 1

[Number of General Power of Attorney] 9713946

[Proof request] Yes

[Document Name] Description

[Title of the Invention] Light source for image writing apparatus, and production method for light source

[Claims]

[Claim 1] A light source of image writing apparatus including a light emitting element, and a light transmitting means forming an image on a photosensitive drum by light emitted from the light emitting element, the light source comprising:

the light emitting element comprises a flat luminous unit; and

the light transmitting means and the light emitting element are formed in one piece.

[Claim 2] The light source of image writing apparatus according to claim 1, wherein the flat luminous unit is an organic electro luminescence.

[Claim 3] The light source according to claim 2, wherein the light transmitting means is a fiber lens alley including a plurality of single lenses.

[Claim 4] The light source according to claim 3, wherein one of the light emitting elements corresponds to one of the single lenses.

[Claim 5] The light source according to claim 3, wherein one of the light emitting elements corresponds to a plurality of the single lenses.

[Claim 6] The light source according to claim 2, wherein a directivity means for orienting the advancing direction of each light from the light emitting element to a specific direction is provided between the light emitting element and the light transmitting mans; and

the light transmitting means, the directivity means, and the light emitting element are formed in one piece.

[Claim 7] The light source according to claim 6, wherein the directivity mean has a mesa structure, and the upper surface of the mesa structure is provided with the light emitting element.

[Claim 8] The light source according to claim 6, wherein the directivity means is a light guide for reflecting the light incident to the directivity means within the directivity means once or plural times.

[Claim 9] A production method of a light source for image writing apparatus including a light emitting element and a light transmitting element forming an image on a photosensitive drum by light emitted from the light emitting element, the production method comprising the steps of;

forming a transparent electrode direct on the light transmitting means;

forming a light emitting layer comprising a flat luminous unit on the transparent

electrode; and

forming a metal electrode layer on the light emitting layer.

[Claim 10] The production method of light source according to claim 9, wherein the transparent electrode is an Indium-Tin Oxide electrode.

[Claim 11] A production method of a light source for image writing apparatus including a light emitting element and a light transmitting element forming an image on a photosensitive drum by light emitted from the light emitting element, the production method comprising the steps of;

forming direct on the light transmitting means a directivity means for orienting an advancing direction of each light emitted from the light emitting element to a specific direction;

forming a transparent electrode on the directivity means; and

forming on the transparent electrode a light emitting layer comprising flat luminous units; and

forming a metal electrode layer on the light emitting layer.

[Claim 12] The production method of light source according to claim 11, wherein the steps of forming the directivity means and the transparent electrode comprise further steps of;

forming direct on the light transmitting means a directivity imparting layer for imparting the directivity to the light;

forming a transparent electrode layer on an upper surface of the directivity imparting layer;

forming the directivity means and the transparent electrode by processing both the directivity imparting layer and the transparent electrode layer simultaneously under the patterning.

[Detailed Description of the Invention]

[0001] [Technical Field]

The present invention relates to a light source for an image writing apparatus and a production method of the light source.

[0002] [Background Art]

The electricphotographic (laser) printer uses a light source 903 as shown in Fig. 9, in order to form a latent image on a photosensitive drum. The light source 903 consists of a plurality of light emitting elements 902 that are disposed on a substrate 901 extended to a main scanning direction. The typical light emitting element 902 is LED (light emitting element). The light souce 903 is placed so as to facing the photosensitive drum 1001 with a light transmitting means 904 intervening between them. The light emitted from the light emitting element 902 irradiates

the photosensitive drum 1001 passing through the light transmitting means 904 comprising the light source, and then the light forms a latent image on the photosensitive drum 1001. As distinct from the liquid display and so on, the light source to be used to the printer requires to obtain correct focus. In order to form the latent image correctly on the photosensitive drum by the light source 903, it is configured so that the angle aperture of the light transmitting means 904 gets small and the focal depth of the light transmitting means 904 is set to deep.

[0003] [Cited document 1] JP 58-46361A

[Cited document 2] JP 58-58566A

[0004] [Problem to be solved by the invention]

Recently, the laser printer has been required to print an image with high resolution. In order to print the image with high resolution, a number of the light emitting elements 902 must be disposed with narrowing each space. In order to dispose a number of the light emitting elements with narrowing each space, the size of the light emitting element 902 must be small.

[0005] In order to print the image with high resolution, the printer must increase the resolution in the sub scanning direction. This increases the number of the scanning per length unit in the sub scanning direction, with the result that the printing time gets long. To print the image with high resolution in a short time, the exposure time per sub scanning line should be shorten. But in such case, it is not possible to obtain the exposure enough to form the latent image on the photosensitive drum 1001.

[0006] A method, which increases the exposure on the photosensitive drum 1001, is to improve the light transmission efficiency by enlarging an angle aperture of a lens composing the light transmitting means 904. However, when the angle aperture was enlarged, the focal depth was made short. Accordingly, it is hard for the light source 903 to form a clear latent image on the photosensitive drum 1001. It generates a problem that the image gets blurred though the resolution is high.

[0007] And, another method for increasing illuminance on the photosensitive drum 1001 is to increase the brightness of the light source by applying much electric field on the light emitting element 902. But, applying the much electric field on the light emitting element 902 not only reduces the luminescence life of the light emitting element but also increases the power consumption.

[0008] Particularly, in case of using the light emitting element 902 as LED, respective the light emitting element 902 and the light transmitting means 904 are formed as a mutually independent

unit, due to the manufacturing method. Therefore, when the two units are incorporated into the light source 903, there is a space having no directivity between the light emitting element 902 and the light transmitting means 904, such as an air layer. Thereby, this depresses the light transmission efficiency between the light emitting element 902 and the light transmitting means 904, and it result in decreasing the light intensity of the light source 903.

[0009] The present invention has an object to provide a light source that makes it possible to perform the high resolution printing with keeping the full focal depth and without reducing the luminous life of the light source.

[0010] [Means for solving problem]

In order to achieve the above object, the present invention employs following means. The invention is a light source for image writing apparatus comprising a light emitting element and a light transmitting means to form an image on a photosensitive drum by light emitted from the light emitting element. The light emitting element is a flat luminance unit, and the light transmitting means and the light emitting element are formed in one piece. The flat luminous unit is an organic electro luminescence.

[0011] In the above configuration, since the light emitting element using the flat luminance unit is formed direct on the light transmitting means, the light emitted from the light emitting element is transmitted direct to the light transmitting means without passing through a layer having low refractive index and no-directivity. The light can reach the photosensitive drum keeping enough luminous intensity, without total reflection. Therefore, without reducing the luminous life of the light emitting element, and without making the focal depth shallow because of enlarging the angle aperture, it is possible to form the latent image with high resolution. On the other hand, in case of the same resolution, it is possible to reduce the electric power consumption.

[0012] One of the light emitting elements may correspond to one of the single lenses, as well as the light transmitting means may be a fiber lens alley including a plurality of single lenses.

[0013] One of the light emitting elements may correspond to a plurality of the single lenses. In this configuration, the diameter of the single lens is smaller than the light emitting means, so that the light emitting element can be formed irrespective of the delicate relation between the light emitting element position and the single lens position, and this makes it to facilitate the production.

[0014] The light source comprises a directivity means for orienting the advancing direction of each light from the light emitting element to a specific direction that is provided between the light emitting element and the light transmitting mans, and wherein the light transmitting means, the

directivity means, and the light emitting element are formed in one piece. In this case, the directivity mean has a mesa structure, and the upper surface of the mesa structure is provided with the light emitting element. It is possible to improve the light transmission efficiency.

[0015] The directivity means may be a light guide for reflecting the light incident to the directivity means within the directivity means once or plural times.

[0016] The light source for image writing apparatus can be produced according to following method. The light source for image writing apparatus has a light emitting element and a light transmitting element forming an image on a photosensitive drum by light emitted from the light emitting element. The production method comprises the steps of forming a transparent electrode direct on the light transmitting means, forming a light emitting layer comprising a flat luminous unit on the transparent electrode, and forming a metal electrode layer on the light emitting layer.

[0017] In addition, when the directivity means is provided to the light source for image writing apparatus including the light emitting element and the light transmitting element forming an image on a photosensitive drum by light emitted from the light emitting element, the production method comprises the steps of forming direct on the light transmitting means a directivity means for orienting an advancing direction of each light emitted from the light emitting element to a specific direction, forming a transparent electrode on the directivity means, forming on the transparent electrode a light emitting layer comprising flat luminous units, and forming a metal electrode layer on the light emitting layer.

[0018] [Best mode for carry out the Invention]

The light source 200 for image writing apparatus in the present invention is used to the color laser printers (which is called a printer hereinafter) 100 as shown in Fig. 1. The general process of the printing by the printer 100 is as follows.

[0019] A recording paper 120 on a tray 101 is fed to a traveling route 103 inside the printer 100 by a carrying roller 102. While the carrying roller 120 is carrying the recording paper 120, a latent image is formed on a photosensitive drum 106.

[0020] The process of forming the latent image is as follows. An electric discharger 105 shown in Fig. 2 removes the latent image on a photosensitive drum 106 that was formed at previous printing, and an electric charger 107 electrically charges the whole of the photosensitive drum 106. Then, the writing light emitted from a light source 200 forms a latent image o the photosensitive drum 106. Finally, a developing device 108 allows the toner to attach to the photosensitive drum 106, and the latent image is formed thereon.

[0021] The printer 100 performs the color printing using four color toners, Y (yellow), M (magenta), C (cyan) and B (black), which is provided with 4 sets of the electric discharger 105, the photosensitive drum 106, the electric charger 107, the light source 200, and the developing device 108, as shown in Fig. 1.

[0022] The visible image formed on each photosensitive drum 106 is transcribed on the recording paper 120 on the traveling route 103, and then a fixing device 109 fixes the visible image thereon. After that, the recording paper 120 is outputted from the printer 100.

[0023] In Fig. 1, a vertical direction on the recording paper is called the main scanning direction and a direction to carry the recording paper 130 is called the sub scanning direction.

[0024] The light source 200 to be used as the light source for the image writing apparatus of the invention has an under-mentioned configuration.

[0025] (Embodiment 1)

The light source 200 in the invention (a light source 301 in Fig. 3) is composed of the light transmitting means 302 and the light emitting element 304. The light transmitting means 302 is necessary for forming the accurate latent image on the photosensitive drum as described above. In this embodiment, the light transmitting means 302 has a structure of fiber lens array. That is, the light transmitting means 302 is formed as follows. A plurality of single lenses 303 with directivity are bundled to one unit, and the gap between the single lenses 303 are filled with light shielding resin. As the single lens, a fiber lens or a rod lens are used, for example. The light emitting element is configured by a flat luminous layer. The organic electro luminescence (which is called the organic EL) is applied to an example of the flat luminous layer.

[0026] Additionally, one of the light emitting elements 304 is provided on the light transmitting means 302 so as to correspond to one of the single lenses 303. The light from the light emitting element 304 illuminates the photosensitive drum 106 through the corresponding single lens 303, and then the latent image is formed thereon.

[0027] Next, the light emitting element 304 is formed direct on the light transmitting means 302, of which production method is described hereinafter.

[0028] The transparent electrode layer, such as the ITO (Indium-Tin Oxide) electrode to be the material of the transparent electrode element, is formed on whole opening surfaces (the upper surfaces of the single lens 303) of the light transmitting means 302 by the evaporation or the application. Thereby, the transparent electrode layer 401 is attached tightly to the light transmitting means 302 in optical.

[0029] Then, only the upper section of each single lens 303 in this embodiment, that is a part from which the light transmitting means 302 emits the ray of light, is masked with the shading film. And the opening surface is subjected to the photolithography like the exposure and the development, or the etching, that is, the patterning. The patterning removes the transparent electrode layer on the parts without masking, while the masked section becomes the transparent electrode element 401.

Next, the organic EL layer 402 is applied on the whole surface of the opening surface on which the transparent electrode element 401 is formed, and then, the metal electrode layer 403 is formed on the upper surface on the organic EL layer 402 as a common electrode.

[0030] Besides, the light emitting element 304 is subjected to the sealing as follows. The adherent resin such as epoxy resin is applied on the sealing section 305 surrounding the opening surface of the light transmitting means 302, and in the last place the metal electrode layer 403 on the opening surface and the resin applied on the periphery thereof are covered with the approximately U-shaped sealing glass. In result, the light source 301 is completed.

[0031] According to the above steps, the light source 301 is formed combining the light transmitting means 302 with the light emitting element 304 in optical one piece. In thus formed light emitting element 304, the organic EL layer 402 between the transparent electrode element 401 and the metal electrode layer 403 emits the ray when the electric field is applied on the transparent electrode element 401 and the metal electrode layer 403.

[0032] Since the light emitting element using the organic EL is formed direct on the light transmitting means, the light emitted from the light emitting element is transmitted direct to the light transmitting means without passing through the low refractive index layer with the low directivity. Accordingly, the light can reach the photosensitive drum keeping the sufficient luminous intensity and no total reflection. Therefore, it is possible to form a latent image with high resolution without shortening the luminescence life of the light emitting element and without the short focal depth due to the large angle aperture. In other words, in case of the same resolution, the power consumption of the light source can be reduced.

[0033] (Embodiment 12)

This embodiment is concerned with the configuration wherein each single lens in the light transmitting means composing the light source 200 (light source 501 in Fig. 5) is made smaller than the light emitting element 304.

[0034] The light source 501 shown in Fig. 5 is formed by disposing the light emitting elements

304 on the light transmitting means 502. As shown in Fig. 6(A), the light transmitting means 502 has a diameter smaller than that of the light emitting element 304. That is to say, one of the light emitting elements 402 corresponds to a plurality of single lenses.

[0035] Regarding the single lens of the light transmitting means, a plurality of single lenses are placed, as the specific number of single lenses is one unit, being surrounded by the light absorbing layers 601 as shown in Fig. 6(B), or each single lens is surrounded by the light absorbing layer 602 as shown in Fig. 6(C).

[0036] The light emitting element 304 may be formed on thus configured light transmitting means 502, of which producing method is the same as Embodiment 1. The diameter of the single lens is smaller than the light emitting element 304 under such configuration, so that the light emitting element can be formed regardless of the delicate positioning relation between the light emitting element and the single lens. In this point of view, the light source can be formed simply more than the aforementioned light source 301 using the light transmitting means 302 described in Embodiment 1.

[0037] (Embodiment 3)

Consequently, here is explained about the light source that is provided with the directivity means between the light emitting element and the light transmitting means for steering the advancing direction of each light emitted from the light emitting element to a predetermined direction, and that is configured by forming the light transmitting means, the directivity means and the light emitting element in one piece.

[0038] The directivity means is for leading more light into the light transmitting means by correcting the advancing direction of each light. The directivity means in Embodiment 3 is provided with the mesa structure (mesa sheet), which is explained here. The mesa structure is for correcting a light direction to a predetermined direction by reflecting the incident light, and is configured in a form of polygonal frustum of pyramid wherein the light emitting element 700 is disposed on the side of the upper surface as shown in Fig. 7(B). Specifically, in case of a directivity means 701 without the mesa structure shown in Fig. 7(A), parts of or most of the light emitted from the light emitting element 700 and incident at a specific incident angle θ, 702, passes through the directivity means 701, so that the volume of the light incident into the bottom 706 could decrease. And the transmission efficiency could come down. On the contrary, in case of a directivity means 704 with the mesa structure in Fig. 7(B), all the light emitted from the light emitting element 8 and incident at a specific incident angle θ, 702, is reflected, so that the volume

of the light incident into the lower surface 707 could not decrease. In result, it is possible to improve the transmission efficiency. Besides, Fig. 7(A) and Fig. 7(B) show a comparison with the same ray of light emitted from the light emitting elements700 and 703.

[0039] Then, the following is concerned with the method of producing the light source combined optically with the directivity means including the mesa structure.

[0040] The directivity imparting layer 802 is formed on the light transmitting means 801 as described in Embodiments 1 and 2, as shown in Fig. 8(A). The forming is carried out by applying or evaporating a material to be the directivity imparting layer thereon. On the directivity imparting layer 802, the ITO electrode layer 803 is applied or evaporated in the same way. Besides, the directivity imparting layer 802 is made of such as Acrylic and Polyarylate, for example.

[0041] The directivity imparting layer 802 and the ITO electrode layer 803 are formed on the light transmitting means 801. After the masking of the specific section, the specific etching removes other sections except the specific section of the ITO layer 803 and the directivity imparting layer 802. Thereby the directivity imparting means 804 with the mesa structure and the ITO electrode 805 can be formed simultaneously as shown in Fig. 8(B). The specific etching is dry etching for forming the mesa structure, for example. The inclined surface to form the mesa structure can be formed by introducing reaction material into the inclined surface forming section (section 808). For example, the reaction material may be introduced in large amount into the section to be etched deeply (a center of the section 808), while a small amount of the reaction material may be introduced into the section to be etched shallow (end of the section 808). That is to say, there is provided on the section 808 with the metal mesh of which opening is adjusted corresponding to a shape to be etched.

[0042] Besides, in case of the general etching instead of the specific etching, the directivity means is not formed to be trapezoid but rectangle, which forms the light guide.

[0043] As described above, the directivity imparting layer and ITO layer are etched simultaneously, so that the process for forming the light source can be reduced. When the ITO layer is formed separating from the directivity imparting layer, the masking requires the position alignment of the mask. But the simultaneous etching eliminates such position alignment and makes it possible to form a high-accurate light emitting element.

[0044]

Next, on the ITO electrode 805 shown in Fig. 8(B), the organic EL to be the light emitting

element 806 is evaporated, and then the metal electrode layer 807 is evaporated thereon. The directivity means 804 is thicker than the ITO electrode 805, the light emitting element 806, or the metal electrode 807. Therefore, since the neighboring layers are disconnected by the section 808 when the light emitting layer 806 or the metal electrode 807 is evaporated on the ITO electrode 805, it is possible to eliminate the masking at the evaporation of the light emitting layer 806 or the metal electrode 807. However, when the metal electrode 807 and the ITO electrode 805 are short-circuited, the light emitting element 8 does not emit the light. Accordingly, the metal electrode 807 may be formed by evaporating the metal on only the upper surface of the light emitting layer 806.

[0045] As described above, since the light transmitting means, the directivity means, and the light emitting layer are combined in one piece, a layer that has the low directivity with the low refractive index does not exist between layers. According to such configuration, the light from the light emitting element is transmitted direct to the light transmitting means without passing through the low directivity layer. Therefore, most of the light can reach the photosensitive drum keeping the sufficient luminous intensity without leakage as described above. In addition, the directivity means in this embodiment steers (corrects) the light from the light emitting element to a specific degree, and this makes it possible to let most of the light from the light emitting element reach the light transmitting means. Moreover, the light that reached the light transmitting means keeps the luminous intensity higher than that in Embodiments 11 and 12 because there is no layer without the directivity.

[0046] Besides, when the light source is provided with the directivity means having the mesa structure, the light transmission efficiency between the organic EL layer and the photosensitive drum could be improved a four times as high as the light source without the directivity means.

[0047] It is not surprising that, if the directivity means is used, the size of the angle aperture is not need to be large to improve the light transmission efficiency. And the focal depth of the light transmitting means remain in deep. It is needless to say that the light source can form a latent image on the photosensitive drum exactly.

[Brief Description of the Drawings]

[Fig. 1] is a schematic block diagram of image writing apparatus.

[Fig. 2] is an enlarged view of the image writing apparatus.

[Fig. 3] is a block diagram of a light source in a first embodiment of the invention.

[Fig. 4] is a schematic block diagram of a light emitting element.

[Fig. 5] is a block diagram of the light source in a second embodiment of the invention.

[Fig. 6] is a schematic block diagram of light transmitting means in the second embodiment.

[Fig. 7] is a diagram that explains the mesa structure.

[Fig. 8] is a diagram showing the production process of forming the light source in a third embodiment.

[Fig. 9] is a diagram showing a conventional light source.

[Fig. 10] is a diagram that indicates respective positions of the conventional light source and photosensitive drums.

[Explanations of letters or numerals]

100	Printer (Image writing apparatus)
101	Tray
102	Carrying roller
103	Traveling route
106	Photosensitive drum
109	Fixing device
130	Sub scanning direction
301	Light source
302	Light transmitting means
303	Single lens
304	Light emitting element
305	Sealing section

[Document Name] Abstract

[Summary]

[Problem to be solved] To provide a light source that makes it possible to perform the higher resolution printing with keeping fully focal depth, and without reducing the luminous life of the light source.

[Solution] The flat luminous unit is used to the light emitting element, and the light transmitting means and the light emitting element are formed in one piece.

[Selected drawing] Fig. 3

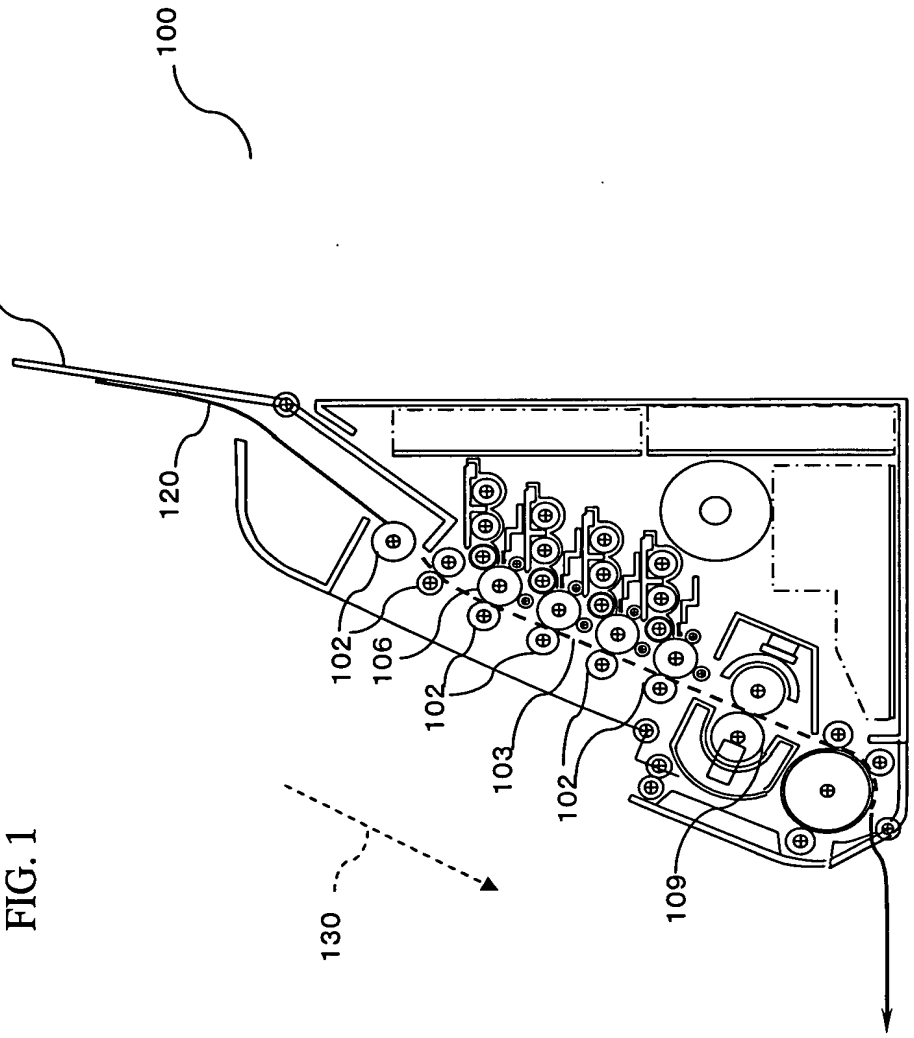


FIG. 1

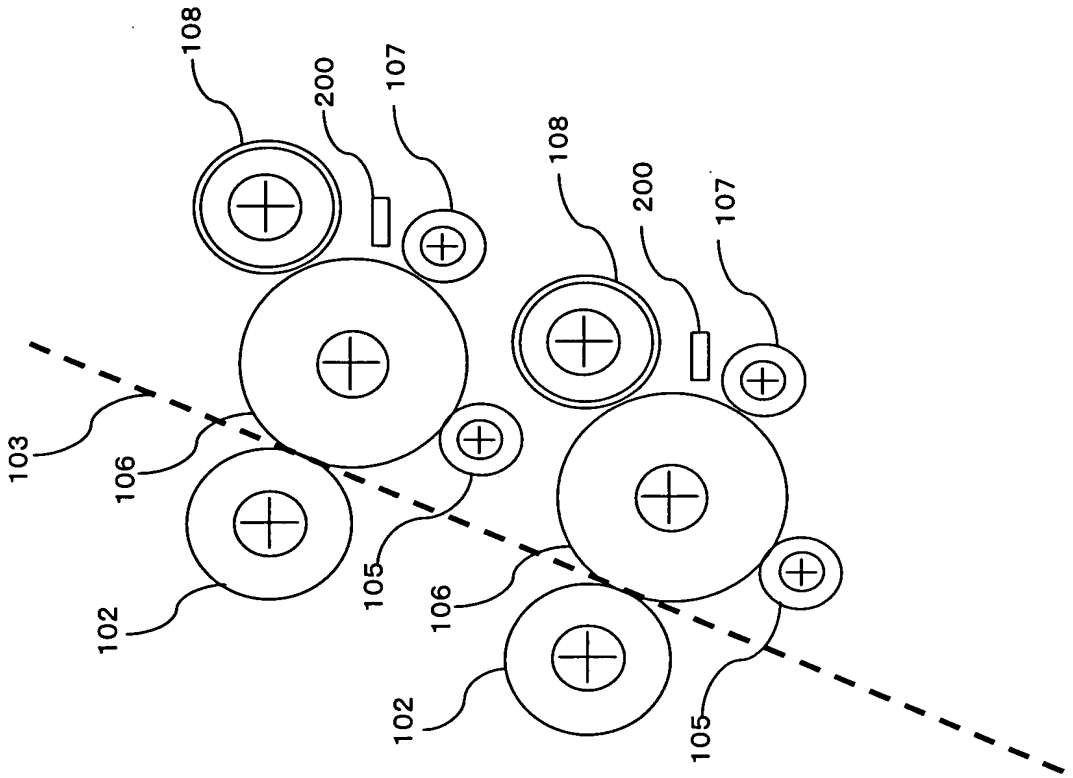


FIG. 2

FIG. 3

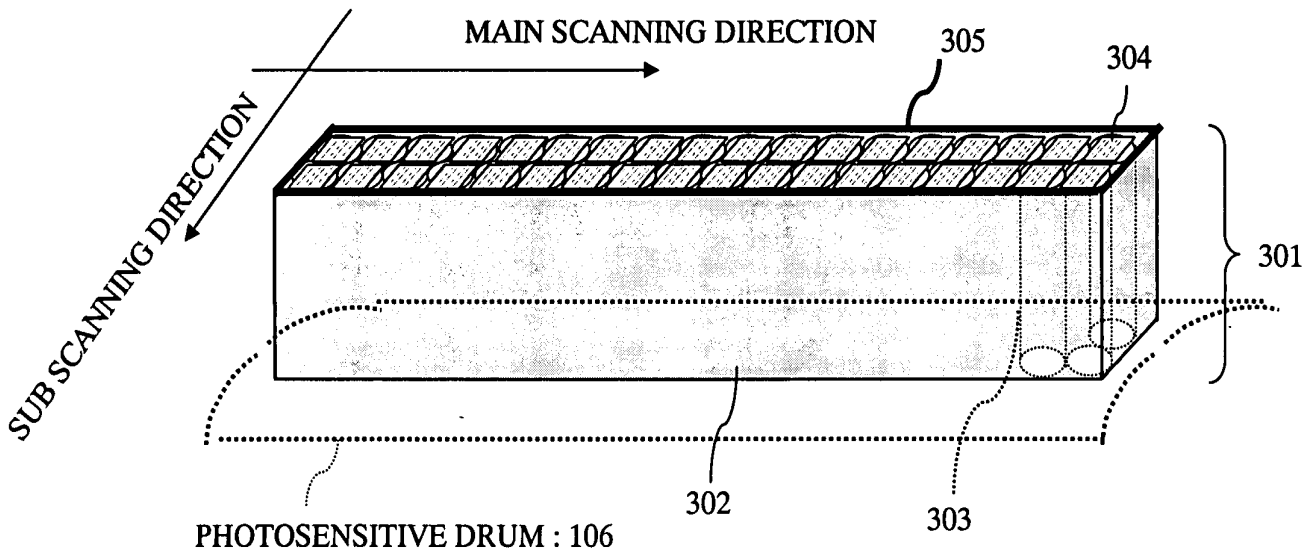

MAIN SCANNING DIRECTION
SUB SCANNING DIRECTION
305
304
301
302
303
PHOTOSENSITIVE DRUM : 106

FIG. 4

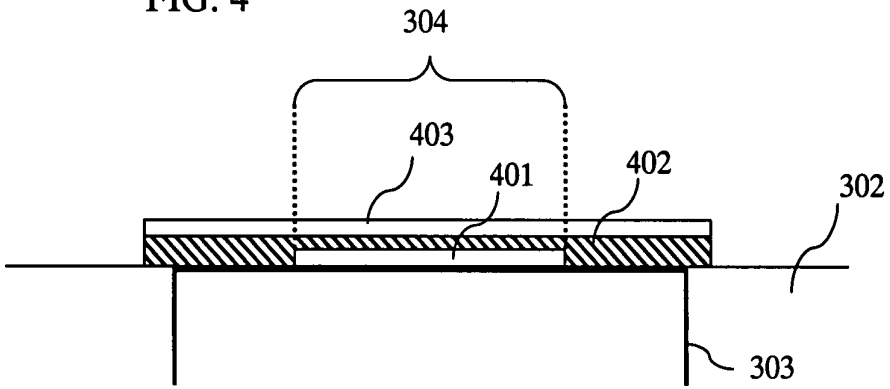


FIG. 5

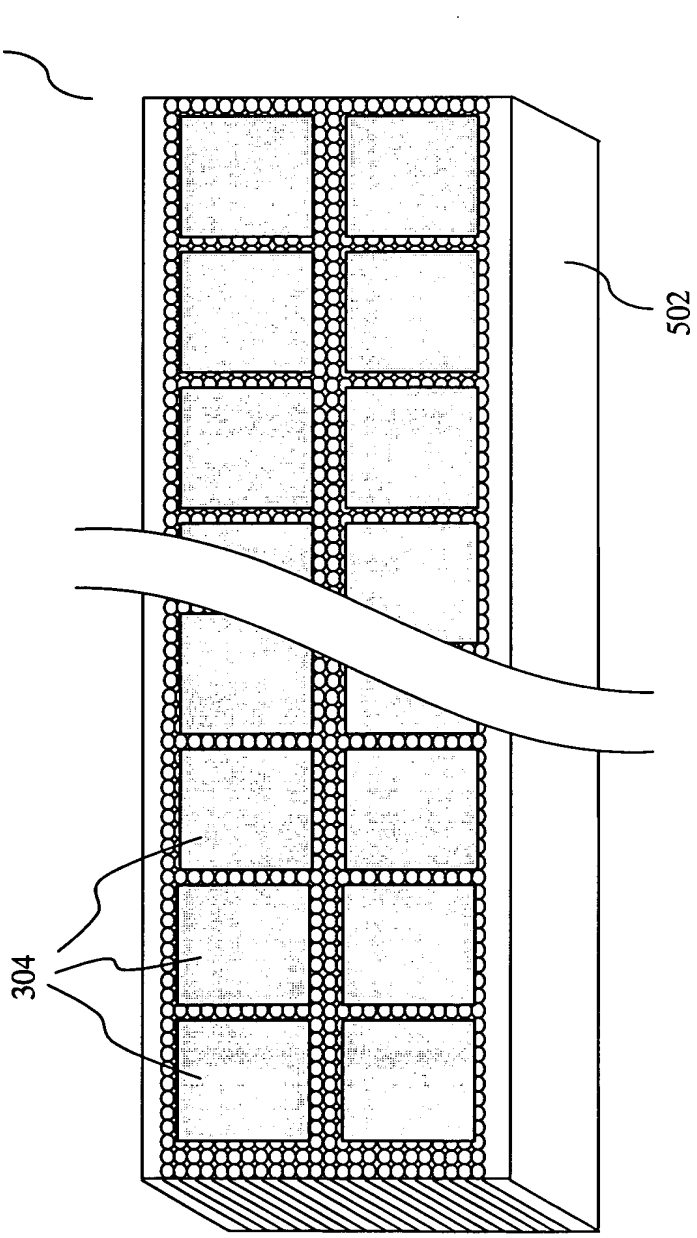


FIG. 6

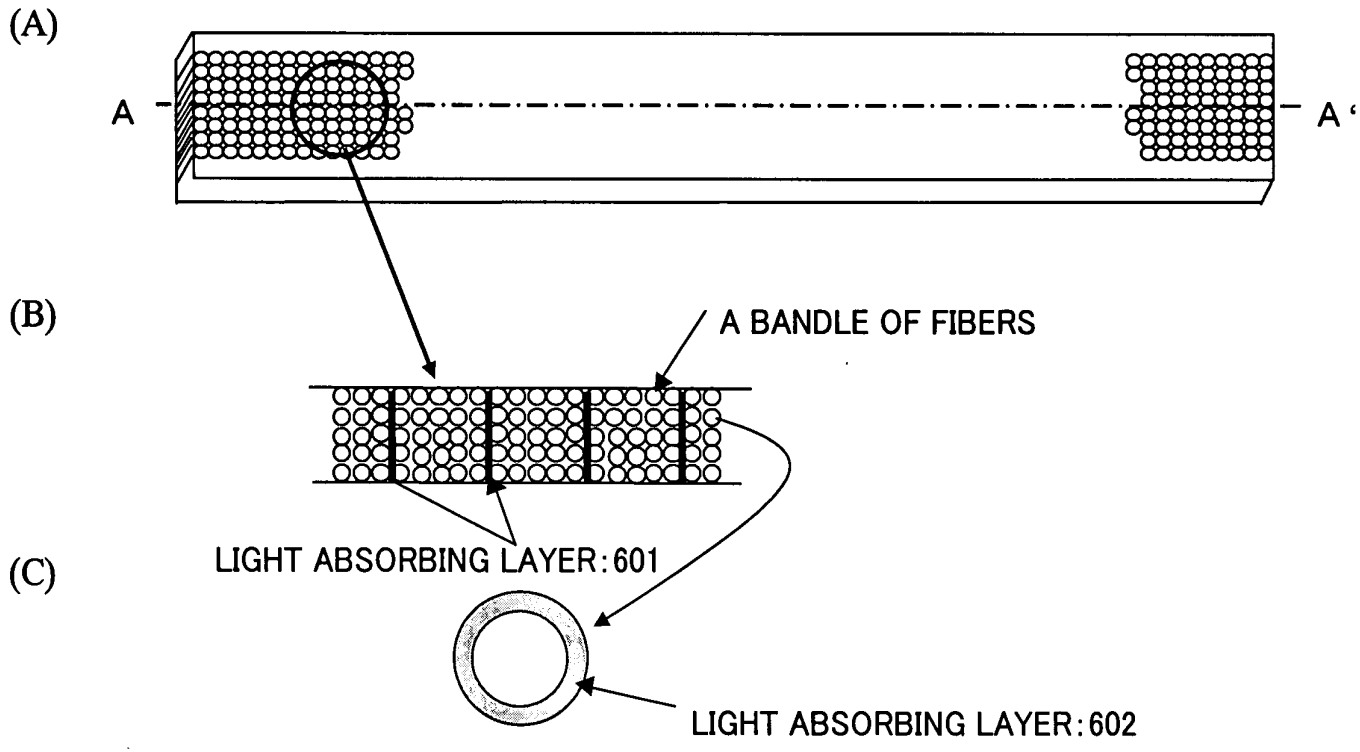

(A)
A
A'
(B)
A BANDLE OF FIBERS
LIGHT ABSORBING LAYER:601
(C)
LIGHT ABSORBING LAYER:602

FIG. 7

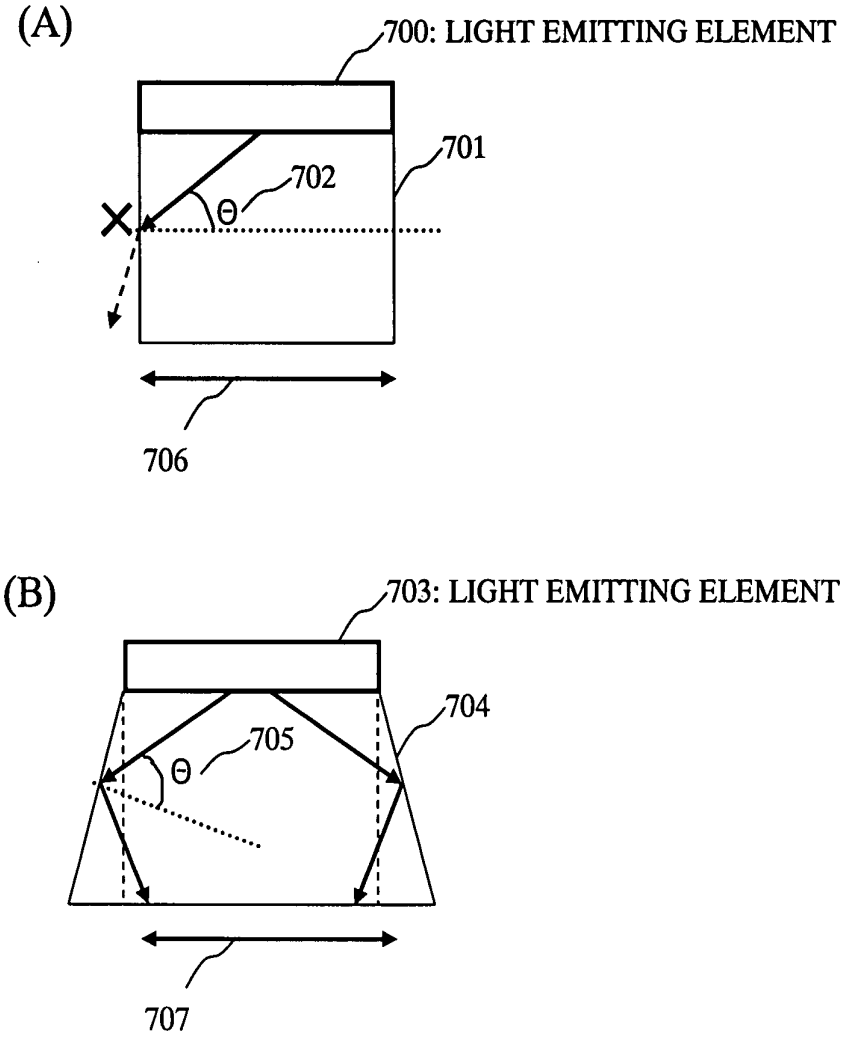
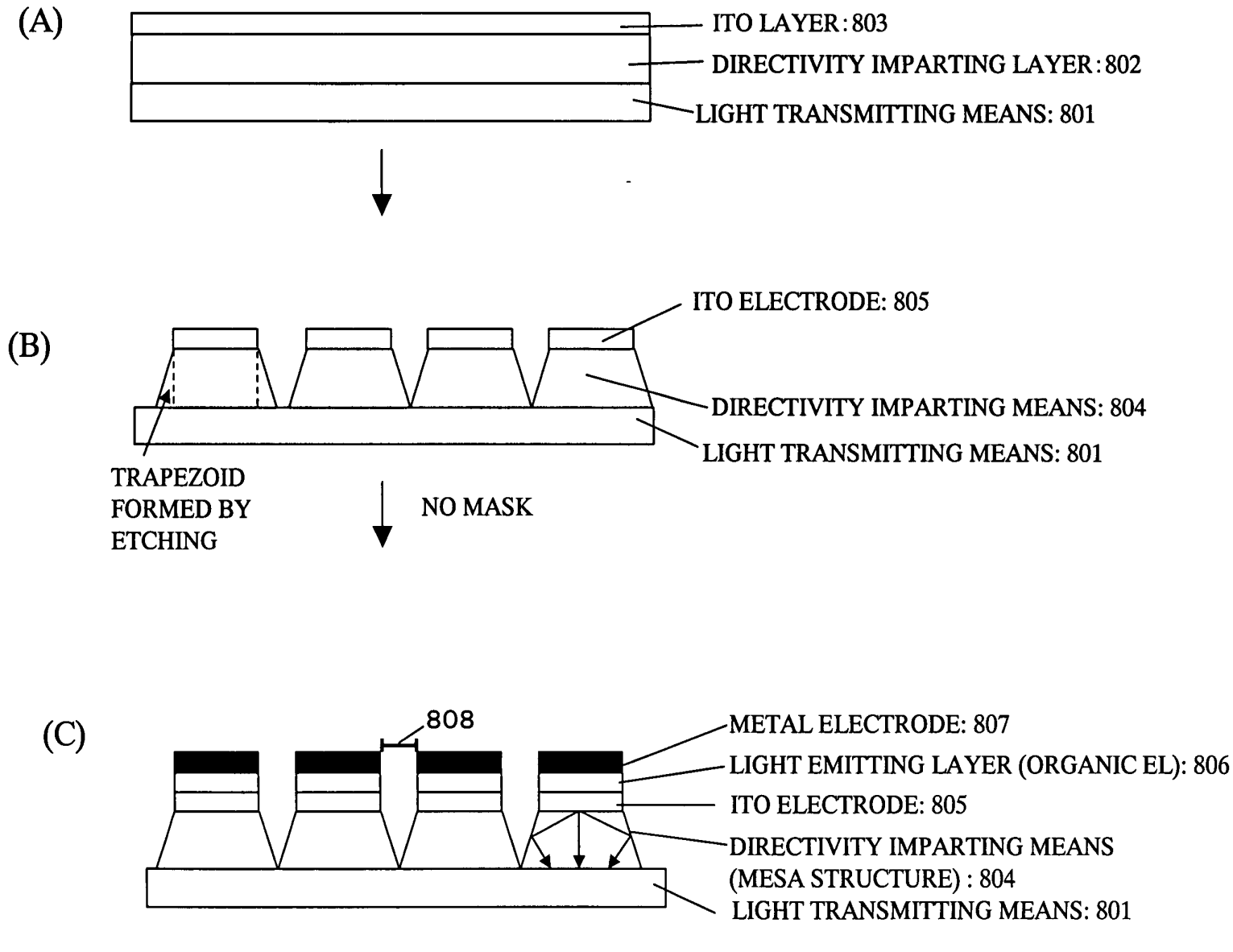

(A)
700: LIGHT EMITTING ELEMENT
701
702
Θ
706
(B)
703: LIGHT EMITTING ELEMENT
704
705
Θ
707

FIG. 8


(A)
ITO LAYER: 803
DIRECTIVITY IMPARTING LAYER: 802
LIGHT TRANSMITTING MEANS: 801
(B)
ITO ELECTRODE: 805
DIRECTIVITY IMPARTING MEANS: 804
LIGHT TRANSMITTING MEANS: 801
TRAPEZOID FORMED BY ETCHING
NO MASK
(C)
808
METAL ELECTRODE: 807
LIGHT EMITTING LAYER (ORGANIC EL): 806
ITO ELECTRODE: 805
DIRECTIVITY IMPARTING MEANS (MESA STRUCTURE) : 804
LIGHT TRANSMITTING MEANS: 801

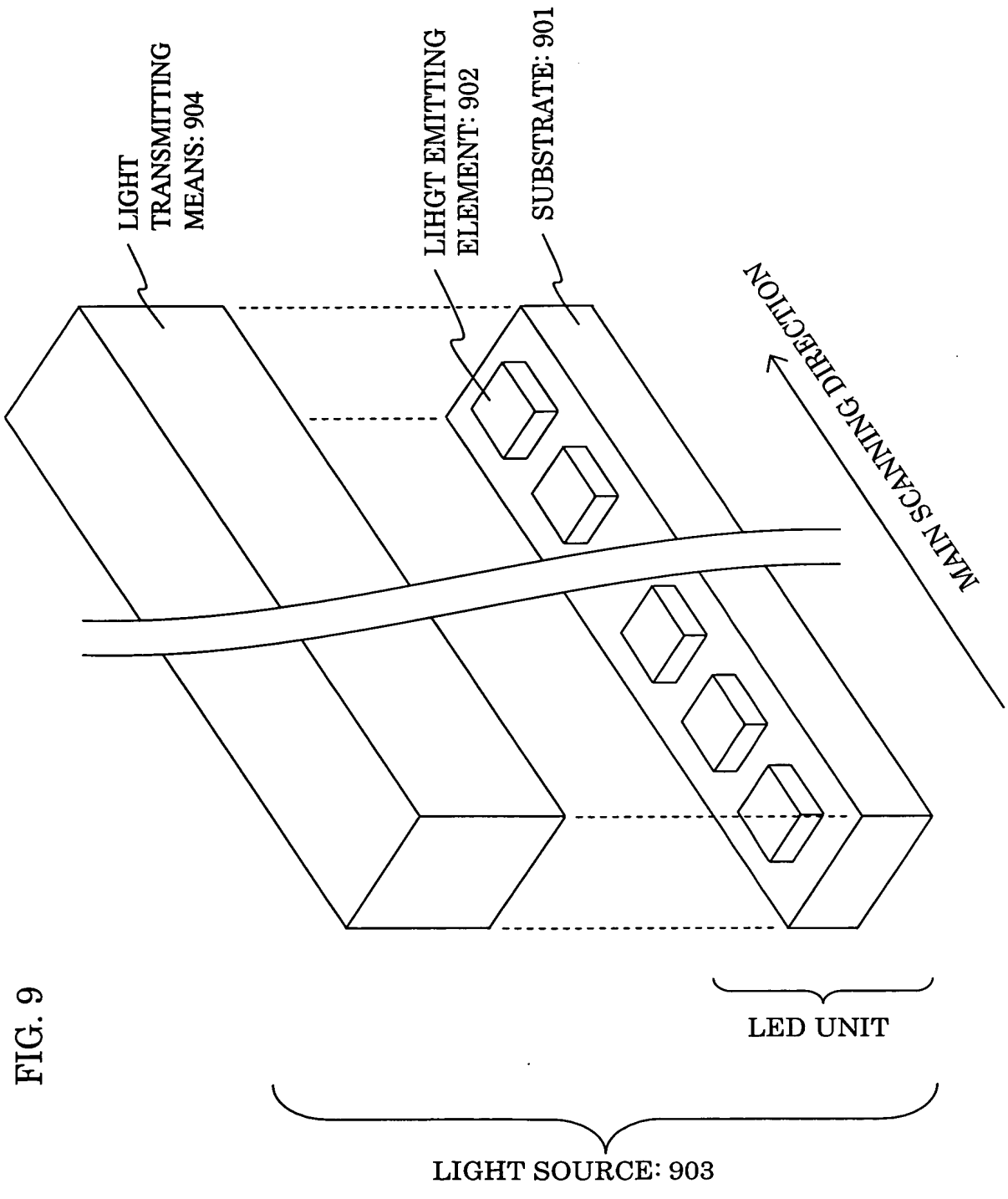
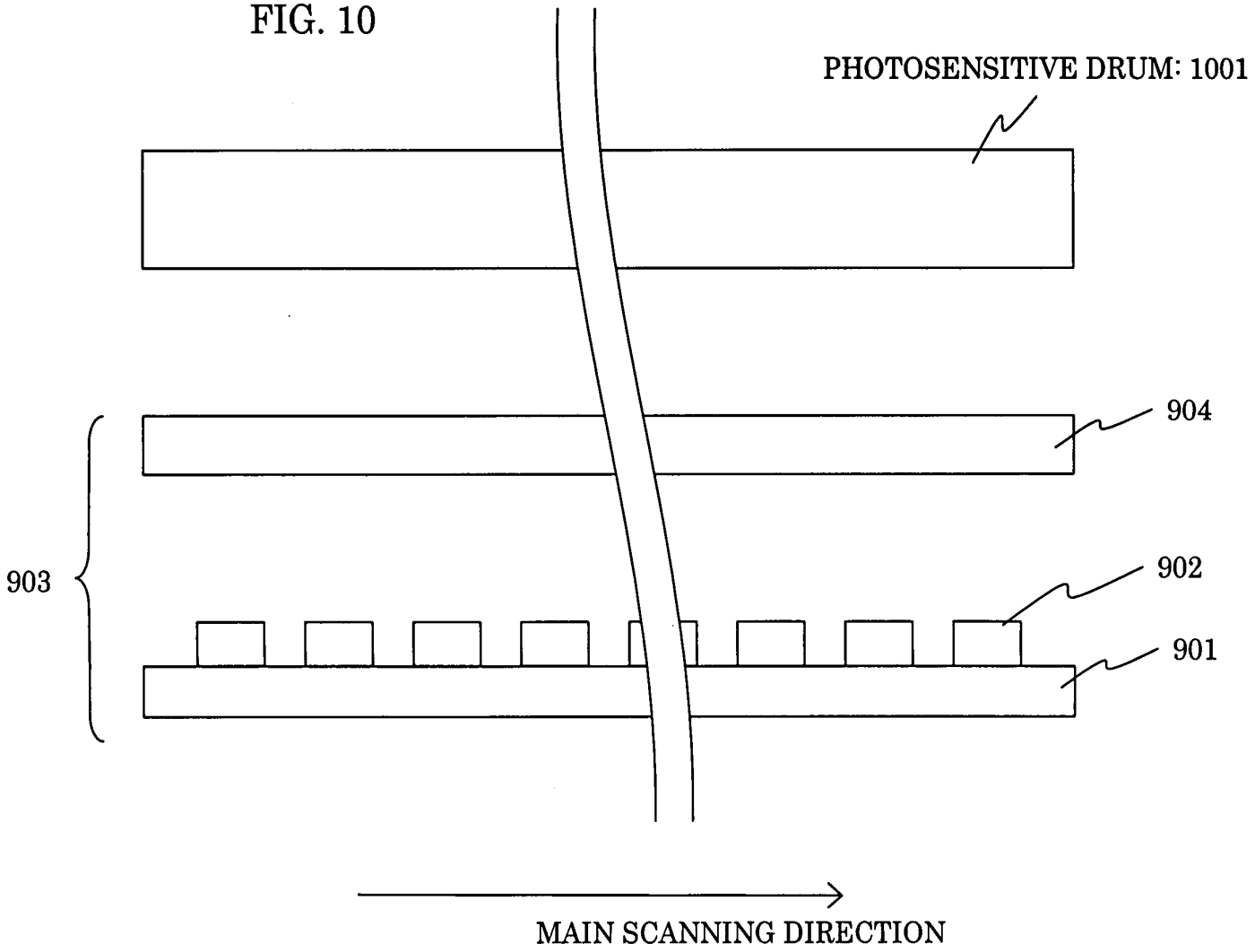

LIGHT TRANSMITTING MEANS: 904
LIHGT EMITTING ELEMENT: 902
SUBSTRATE: 901
MAIN SCANNING DIRECTION
LED UNIT
LIGHT SOURCE: 903

FIG. 9

FIG. 10


PHOTOSENSITIVE DRUM: 1001
904
903
902
901
MAIN SCANNING DIRECTION